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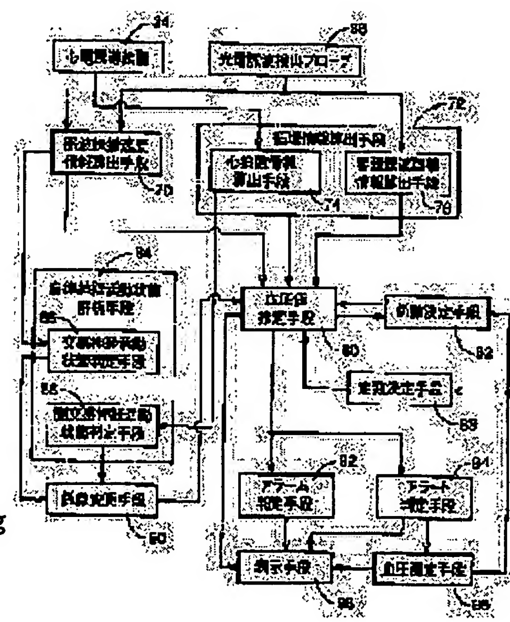
(54) BLOODLESS AND CONSECUTIVE BLOOD PRESSURE ESTIMATING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a noninvasive and consecutive blood pressure estimating device capable of obtaining high estimating precision with respect to an estimated blood pressure value.

SOLUTION: A blood pressure estimating means 80 calculates an estimated blood pressure EBPSYS based on an actual time difference DTRP, a cardiac period PR and a capacity pulse wave area ratio VR from the previously stored relation (a prescribed formula) between an estimated blood pressure EBP and a pulse wave propagating time DTRP, a cardiac period PR and a capacity pulse wave area ratio VR. Consequently, high estimating precision is obtained with respect to the value EBPSYS compared with the case of estimating the blood pressure of an organism based on the time DTRP, thereby it is not required to frequently execute proofreading with a blood pressure BP measured through the use of a cuff. In addition a coefficient deciding means 82 decides the coefficient of the prescribed formula by selecting the coefficient value of a set corresponding to a highest blood pressure BPSYS measured by using a cuff from plural sets of coefficient values previously stored for each of plural blood pressure ranges, thereby the precision of this formula is improved and the estimated highest blood pressure EBPSYS is precisely obtained compared with a case when the coefficient is fixed in advance.



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CLAIMS

[Claim(s)]
[Claim 1] It is noninvasive continuation blood-pressure presumption equipment for presuming a living body's arterial tension from information acquired from a living body's circulatory organ in non-invasion. A pulse-wave-velocity information calculation means to compute pulse-wave-velocity information relevant to pulse wave velocity in said living body's artery, A circulation information calculation means to compute either [at least] heart rate information relevant to said living body's heart rate, or plethysmogram area information relevant to area of a plethysmogram in this living body's peripheral section, Pulse-wave-velocity information relevant to pulse wave velocity in relation memorized beforehand to said living body's artery, A blood-pressure value presumption means to presume said living body's blood-pressure value based on either [at least] heart rate information relevant to this living body's heart rate, or plethysmogram area information relevant to area of a plethysmogram in this living body's peripheral section, Noninvasive continuation blood-pressure presumption equipment characterized by including a coefficient decision means to determine a coefficient of relation used in said blood-pressure value presumption means by choosing a coefficient value of a group corresponding to said living body's actual blood-pressure value from two or more sets of coefficient values beforehand memorized for two or more blood-pressure value range of every.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the noninvasive continuation blood-pressure presumption equipment for presuming a living body's arterial tension from the information acquired from a living body's circulatory organ in non-invasion.
[0002]
[Description of the Prior Art] The equipment which determines a living body's blood-pressure value based on change of the Korotkoff sounds generated in the process in which the compression pressure of the tourniquet wound around some living bodies is changed as blood-pressure-measurement equipment of the non-invasion for measuring a living body's arterial tension, or change of the cuff pulse wave amplitude is known. The so-called automatic blood-pressure-measurement equipment of a Korotkoff-sounds method or the automatic blood-pressure-measurement equipment of an oscillograph metric method is it.
[0003]
[Problem(s) to be Solved by the Invention] By the way, although to measure a living body's blood-pressure value continuously as much as possible may be desired in an operating room or an intensive care unit in order to require the urgency of treatment or a therapy With said conventional automatic blood-pressure-measurement equipment, if dozens seconds do not pass since the starting, in order to acquire a blood-pressure value a short period as much as possible for a blood-pressure-measurement value not to not only be acquired, but, when the starting period was shortened, there was a defect that the blood-pressure-measurement error resulting from the congestion and it by pressure of the tourniquet occurred.
[0004] On the other hand, the propagation velocity of the pulse wave which spreads the inside of a living body's artery is computed based on the signal acquired by non-invasion, and the non-invasion continuation blood-pressure presumption equipment of presuming a living body's blood-pressure value continuously based on the propagation velocity from the relation memorized beforehand is proposed. For example, the equipment indicated by JP,7-9305,U and JP,7-308295,A is it.
[0005] However, the above-mentioned conventional non-invasion continuation blood-pressure presumption equipment Only the technology of presuming a blood-pressure value continuously only using the pulse wave propagation time or pulse wave velocity is indicated. In presuming a blood-pressure value only using the pulse wave propagation time or pulse wave velocity such Since precision sufficient about a presumed blood-pressure value could not be acquired, there was un-arranging [which needs frequent proofreading between the blood-pressure values measured by the automatic blood-pressure-measurement equipment of a Korotkoff-sounds method using the tourniquet or the automatic blood-pressure-measurement equipment of an oscillograph metric method].
[0006] The place which succeeds in this invention against the background of the above situation, and is made into the purpose is to offer the non-invasion continuation blood-pressure presumption equipment with which a high presumed precision is acquired to a presumed blood-pressure value.
[0007]
[Means for Solving the Problem] A place made into a summary of this invention for attaining this purpose It is noninvasive continuation blood-pressure presumption equipment for presuming a living body's arterial tension from information acquired from a living body's circulatory organ in non-invasion. (a) A pulse-wave-velocity information calculation means to compute pulse-wave-velocity information relevant to pulse wave velocity in said living body's artery, (b) A circulation information calculation means to compute either [at least] heart rate information relevant to said living body's heart rate, or plethysmogram area information relevant to area of a plethysmogram in the living body's

peripheral section, (c) Pulse-wave-velocity information relevant to pulse wave velocity in relation memorized beforehand to said living body's artery, A blood-pressure value presumption means to presume said living body's blood-pressure value based on either [at least] heart rate information relevant to the living body's heart rate, or plethysmogram area information relevant to area of a plethysmogram in the living body's peripheral section, (d) It is in including a coefficient decision means to determine a coefficient of relation used in said blood-pressure value presumption means by choosing a coefficient value of a group corresponding to said living body's actual blood-pressure value from two or more sets of coefficient values beforehand memorized for two or more blood-pressure value range of every.

[0008]

[Effect of the Invention] If it does in this way, since a living body's blood-pressure value is presumed by the blood-pressure value presumption means based on either [at least] pulse-wave-velocity information, heart rate information or plethysmogram area information, a high presumed precision will be acquired from the relation set up beforehand to a presumed blood-pressure value by it. That is, since at least one side of the plethysmogram area information which is a parameter by the side of the tip which changes in relation to the heart rate information which is a parameter by the side of the heart which changes in relation to a living body's blood-pressure value, and a living body's blood-pressure value is further used as compared with the case where a living body's blood-pressure value is presumed only based on pulse-wave-velocity information, presumed precision is further raised to a presumed blood-pressure value. moreover, from the coefficient of the relation used in said blood-pressure value presumption means by the coefficient decision means by choosing the coefficient value of the group corresponding to said living body's actual blood-pressure value from two or more sets of coefficient values beforehand memorized for two or more blood-pressure value range of every being determined There is an advantage from which the precision of the relation for determining a presumed blood-pressure value is raised as compared with the case where the coefficient of relation is the constant value defined beforehand, and presumed blood pressure is obtained correctly.

[0009]

[Other modes of invention] Here, said blood-pressure value presumption means presumes said living body's blood-pressure value from the relation memorized beforehand suitably based on the pulse-wave-velocity information relevant to the pulse wave velocity in said living body's artery, the heart rate information relevant to the living body's heart rate, and the plethysmogram area information relevant to the area of the plethysmogram in the living body's peripheral section. It compares, when a living body's blood-pressure value will be presumed only based on pulse-wave-velocity information, if it does in this way. Since the plethysmogram area information which is a parameter by the side of the tip which changes in relation to the heart rate information and the blood-pressure value which are a parameter by the side of the heart which changes in relation to a blood-pressure value is used further Presumed precision does not need to be further raised to a presumed blood-pressure value, and proofreading with the blood-pressure value measured using the tourniquet does not need to be performed frequently.

[0010] Suitably said blood-pressure value presumption means Moreover, the presumed blood pressure EBP and the pulse wave propagation time DT Relation beforehand memorized between a cardiac cycle RR and the plethysmogram surface ratio VR (EBP=alpha (1-/DT) +beta RR+gamma VR+delta) However, alpha, beta, and gamma compute the presumed blood pressure EBP from a coefficient and delta being constants based on the actual pulse wave propagation time DT and an actual cardiac cycle RR, and the plethysmogram surface ratio VR. If it does in this way, it will compare, when a living body's blood-pressure value is presumed only based on pulse-wave-velocity information. Since the plethysmogram surface ratio VR which is a parameter by the side of the tip which changes in relation to the cardiac cycle RR and blood-pressure value which are a parameter by the side of the heart which changes in relation to a blood-pressure value is used further Presumed precision does not need to be further raised to a presumed blood-pressure value, and proofreading with the blood-pressure value measured using the tourniquet does not need to be performed frequently.

[0011] Moreover, said coefficients alpha, beta, and gamma and constant delta are suitably called for using a multiple regression analysis from the data of the pulse wave propagation time DT when a blood-pressure value and its blood-pressure value are acquired, a cardiac cycle RR, and the a large number people containing the plethysmogram surface ratio VR. If it does in this way, there is an advantage from which the relation in which the general purpose for acquiring a presumed blood-pressure value is possible is obtained.

[0012] Moreover, the presumed blood-pressure value presumed by said blood-pressure value presumption means as said living body's actual blood-pressure value is suitably used for said coefficient decision means. The coefficient of the relation used in said blood-pressure value presumption means by choosing the coefficient value of the group corresponding to the presumed blood-pressure value of a up Norio object from two or more sets of coefficient values

beforehand memorized for said two or more blood-pressure value range of every is determined. If it does in this way, there is an advantage for which the coefficient value of the optimal group corresponding to the presumed blood-pressure value presumed serially is used promptly.
[0013] Moreover, change of the Korotkoff sounds generated in the process in which the compression pressure of the tourniquet wound around some living bodies is changed suitably, A blood-pressure-measurement means to determine a living body's blood-pressure value based on change of the cuff pulse wave amplitude is included. Or said coefficient decision means The blood-pressure value measured in the blood-pressure-measurement means as said living body's actual blood-pressure value is used. The coefficient of the relation used in said blood-pressure value presumption means is determined by choosing the coefficient value of the group corresponding to a living body's blood-pressure value measured using the tourniquet from two or more sets of coefficient values beforehand memorized for said two or more blood-pressure value range of every. If it does in this way, there is an advantage for which the coefficient value of the optimal group corresponding to a living body's more reliable blood-pressure value measured using the tourniquet, for example, alpha, beta, and gamma, is used promptly.
[0014] In moreover, the relation as which the coefficient value of the group corresponding to a living body's blood-pressure value measured using the tourniquet in said coefficient decision means was chosen suitably The presumed blood-pressure value which assigns the value at the time of the blood pressure measurement using said one [at least] tourniquet of the information used for the relation, i.e., said pulse-wave-velocity information and heart rate information, and plethysmogram area information, and is acquired, A constant decision means to determine the constant of the constant term of said relation is included so that the blood-pressure value measured using the tourniquet may be in agreement. If it does in this way, there is an advantage to which the reliability of the blood-pressure value presumed in said blood-pressure value presumption means becomes still higher.
[0015]
[The gestalt of suitable implementation of invention] Hereafter, one example of this invention is explained to details based on a drawing. Drawing 1 is a block diagram explaining the circuitry of the noninvasive continuation blood-pressure presumption equipment 8 with which this invention was applied.
[0016] In drawing 1 , noninvasive continuation blood-pressure presumption equipment 8 is equipped with the cuff 10 which has rubber bag making in the band-like bag made of cloth, for example, is wound around a patient's overarm section 12, and the pressure sensor 14 connected to this cuff 10 through piping 20, respectively, a change-over valve 16 and an air pump 18. This change-over valve 16 is constituted so that it may be switched to three conditions, the pressure supply condition of permitting supply of the pressure into a cuff 10, the **** exhaust-gas-pressure condition which carries out exhaust gas pressure of the inside of a cuff 10 gradually, and the rapid exhaust-gas-pressure condition which carries out exhaust gas pressure of the inside of a cuff 10 quickly.
[0017] A pressure sensor 14 detects the pressure in a cuff 10, and supplies the pressure signal SP showing the pressure to the static pressure discriminator 22 and the pulse wave discriminator 24, respectively. The static pressure discriminator 22 is equipped with a low pass filter, discriminates from the cuff pressure signal SK showing steady pressure, i.e., cuff pressure, contained in the pressure signal SP, and supplies the cuff pressure signal SK to an electronic control 28 through A/D converter 26. It is the pulse wave signal SM 1 which the pulse wave discriminator 24 is equipped with a band pass filter, and is the oscillating component of the pressure signal SP. It discriminates in frequency and is the pulse wave signal SM 1. An electronic control 28 is supplied through A/D converter 30. This pulse wave signal SM 1 The cuff pulse wave to express is a pressure oscillatory wave which occurs from the brachial artery which is not illustrated synchronizing with a patient's heartbeat, and is transmitted to a cuff 10.
[0018] the above-mentioned electronic control 28 consists of so-called microcomputers equipped with CPU29, ROM31, RAM33, the I/O Port that is not a drawing example, and using the memory storage function of RAM33 for ROM31 according to the program memorized beforehand, by performing signal processing, it outputs a driving signal from an I/O Port, and CPU29 controls a change-over valve 16 and an air pump 18.
[0019] It is the signal SM 2 which the electrocardio guide 34 detects continuously the electrocardio induction wave which shows the action potential of a myocardium through two or more electrodes 36 stuck and stuck to a living body's predetermined part, and the so-called electrocardiogram, and shows the electrocardio induction wave. Said electronic control 28 is supplied. In addition, this electrocardio guide 34 is for detecting the Q wave of the electrocardio induction waves corresponding to the stage carrying out ejection initiation of the blood in the heart toward a main artery, or an R wave.
[0020] The photoelectrical pulse wave detection probe 38 (only henceforth a probe) for pulse oximeters does not function as a peripheral pulse wave detection means to detect the pulse wave spread to the peripheral artery containing a capillary, and it is equipped with it in the condition of having stuck with the wearing band which is not illustrated to an

operating personnel-ed, for example, the living body skins 40, i.e., body surfaces, such as the finger tip section. The housing 42 of the shape of a container which carries out the opening of the probe 38 in an one direction, Two or more 1st light emitting device 44a which is prepared in the portion located in the periphery side of the bottom circles side of the housing 42, and consists of LED etc. And 2nd light emitting device 44b (the following, especially when not distinguishing, it is only called a light emitting device 44), The photo detector 46 which is prepared in a part for the center section of the bottom circles side of housing 42, and consists of a photodiode, a photo transistor, etc., The transparent resin 48 which is prepared in one in housing 42 and covers a light emitting device 44 and a photo detector 46, It is prepared between a light emitting device 44 and a photo detector 46 in housing 42, and it has the annular covered member 50 which shades the reflected light which goes to a photo detector 46, and consists of the body surface 40 of the light irradiated toward said body surface 40 from the light emitting device 44.

[0021] 1st light emitting device of the above 44a Light is emitted, for example in red light with a wavelength of about 660nm, and it is 2nd light emitting device 44b. For example, light is emitted in infrared light with a wavelength of about 800nm. These 1st light emitting device 44a And 2nd light emitting device 44b While being made to emit light with predetermined frequency by fixed time amount [every] sequence, the reflected light from the part by which it is crowded with the capillaries of the inside of the body of the light irradiated toward said body surface 40 from these light emitting devices 44 is received by the common photo detector 46, respectively. in addition, the wavelength of the light in which a light emitting device 44 emits light is restricted to the above-mentioned value -- not having -- 1st light emitting device 44a the light of the wavelength from which the absorbancy index of an oxyhemoglobin and the reduced hemoglobin differs greatly -- 2nd light emitting device 44b those absorbancy indexes -- abbreviation -- what is necessary is just to emit light, respectively in the light of the wavelength which becomes the same, i.e., the wavelength reflected by an oxyhemoglobin and the reduced hemoglobin

[0022] It is the photoelectrical pulse wave signal SM 3 of the magnitude corresponding to the light income in a photo detector 46. It outputs through a low pass filter 52. Between a photo detector 46 and a low pass filter 52, amplifier etc. is formed suitably. photoelectrical pulse wave signal SM 3 into which the low pass filter 52 was inputted from -- signal SM 3 with which the noise which has frequency higher than the frequency of a pulse wave was removed, and the noise was removed It outputs to a demultiplexer 54. This photoelectrical pulse wave signal SM 3 The photoelectrical pulse wave to express is a plethysmogram generated synchronizing with a patient's pulse. In addition, this photoelectrical pulse wave supports pulse synchronization voltage.

[0023] A demultiplexer 54 follows a signal from an electronic control 28, and is 1st light emitting device 44a. And 2nd light emitting device 44b Electrical signal SMR according to red light by being switched synchronizing with luminescence The I/O Port with which an electronic control 28 does not illustrate the electrical signal SMIR by infrared light through a sample hold circuit 60 and A/D converter 62, respectively is serially supplied through a sample hold circuit 56 and A/D converter 58. Sample hold circuits 56 and 60 are for holding the electrical signal SMR which will be outputted to a degree by the time the conversion actuation in the electrical signal SMR outputted last time and A/D converters 58 and 62 about SMIR is completed, in case the inputted electrical signal SMR and SMIR are outputted to A/D converters 58 and 62, and SMIR, respectively.

[0024] CPU29 of an electronic control 28 performs measurement actuation according to the program memorized beforehand to ROM31, using the memory storage function of RAM33. A control signal SLV is outputted to the drive circuit 64, and they are light emitting device 44a and 44b. While making light emit fixed time amount every on predetermined frequency one by one These light emitting device 44a and 44b By outputting the change over signal SC synchronizing with luminescence, and switching a demultiplexer 54, it is said electrical signal SMR. An electrical signal SMIR is distributed to a sample hold circuit 56 in a sample hold circuit 60, respectively. The above CPU 29 computes a living body's saturation of oxygen in blood based on the above-mentioned electrical signal SMR and the amplitude value of SMIR from the operation expression memorized beforehand, in order to compute the saturation of oxygen in blood. In addition, as the decision method of this saturation of oxygen, the decision method indicated by JP,3-15440,A which these people applied previously and was exhibited is used, for example.

[0025] Drawing 2 is a functional block diagram explaining the important section of the control function of the electronic control 28 in the above-mentioned noninvasive continuation blood-pressure presumption equipment 8. Setting to drawing 2 , the pulse-wave-velocity information calculation means 70 is the pulse wave propagation time DTRP or pulse wave velocity VM. The pulse-wave-velocity information relevant to the propagation velocity of a pulse wave [like] is computed serially. for example, predetermined part, for example, R wave, generated for every electrocardio induction wave period serially detected with the electrocardio guide 34 as shown in drawing 3 It has a time difference calculation means to compute serially the time difference (pulse wave propagation time) DTRP to the predetermined part, for example, a standup point, generated for every period of the photoelectrical pulse wave serially detected by the

probe 38, or a bottom peak point. Based on time difference DT<SUB>RP serially computed by the time difference calculation means, the propagation velocity VM of the pulse wave which spreads the inside of the artery of an operating personnel-ed (m/sec) is serially computed from the formula 1 memorized beforehand. In addition, in a formula 1, L (m) is the distance to the part where it is equipped with said probe 38 through a main artery from the ventriclus sinister, and TPEP (sec) is a precursive appearance period from the R wave of an electrocardio induction wave to the bottom peak point of a photoelectrical pulse wave. Such distance L and precursive appearance period TPEP It is a constant and the value calculated experimentally beforehand is used.

[0026]

[Equation 1] VM =L/(DTRP-TPEP)

[0027] The circulation information calculation means 72 is constituted at least including one side of a heart rate information calculation means 74 to compute the heart rate information HR relevant to a living body's heart rate HR, for example, a heart rate, a cardiac cycle RR, a pulse rate, a pulse period, etc., and a plethysmogram area information calculation means 76 to compute the plethysmogram area information relevant to the area of the plethysmogram in a living body's peripheral section. To the plethysmogram area information relevant to the area of the plethysmogram in the peripheral section of a up Norio object For example, the plethysmogram surface ratio VR defined as the area VP of a plethysmogram, and a product (= VP/RR) of the plethysmogram area VP and inverse number of a cardiac cycle RR Amplitude amendment plethysmogram surface ratio VR' defined as a product (=VRxL) of the plethysmogram surface ratio VR and pulse wave amplitude L, the plethysmogram area VP -- a cardiac cycle RR and the pulse wave amplitude L -- being based -- normalizing -- VP -- / (RRxL) -- the normalization pulse wave area called for by performing an operation is contained. For example, since the photoelectrical pulse wave inputted from a probe 38 is constituted by the sequence of the point which shows the magnitude of the photoelectrical pulse wave inputted for every several mm or sampling period in every dozens of mm as shown in drawing 4 , the area VP of a photoelectrical pulse wave asks for it by integrating with a photoelectrical pulse wave in the one period RR (addition). The above-mentioned heart rate information and plethysmogram area information are changed in relation to both change of blood pressure. That is, change of blood pressure takes place by change of the cardiac output by the side of a center, and change of the peripheral vascular resistance by the side of a tip, and, in the above-mentioned heart rate information, plethysmogram area information reflects the magnitude of peripheral vascular resistance reflecting a cardiac output.

[0028] The blood-pressure value presumption means 80 presumes a living body's blood-pressure value from the relation memorized beforehand based on either [at least] said pulse-wave-velocity information and heart rate information, or plethysmogram area information. for example, from the relation beforehand memorized between the pulse wave propagation time DTRP shown in a formula 2, a cardiac cycle RR, and the plethysmogram surface ratio VR The presumed blood-pressure value EBP is computed based on the actual cardiac cycle RR computed with the actual pulse wave propagation time DTRP computed with the pulse-wave-velocity information calculation means 70, and the heart rate information calculation means 74, and the actual plethysmogram surface ratio VR computed with the plethysmogram area information calculation means 76.

[0029]

[Equation 2]

EBP=alpha (1-/DTRP) +beta RR+gamma VR+delta (alpha, beta, and gamma are a coefficient, and delta is a constant)

[0030] The coefficient decision means 82 is determined by choosing the coefficient value of the group corresponding to a living body's actual blood-pressure value from two or more sets of coefficient values beforehand memorized for two or more blood-pressure value range of every in the coefficient of the relational expression used in order to compute the presumed blood-pressure value EBP in the blood-pressure value presumption means 80. For example, highest-blood-pressure value BPSYS measured using the cuff 10 from two or more sets of coefficient values beforehand memorized for two or more above-mentioned blood-pressure value range of every, using the blood-pressure value measured using the cuff 10 in a blood-pressure-measurement means 96 to mention later as an actual blood-pressure value The coefficient value of a corresponding group is chosen. In this case, the presumed blood-pressure value presumed in the blood-pressure value presumption means 80 is the estimate EBPSYS of a highest-blood-pressure value, i.e., a presumed highest-blood-pressure value. It becomes. Furthermore, the coefficient value of the group corresponding to the presumed blood-pressure value EBP computed serially is chosen from two or more sets of coefficient values beforehand memorized for two or more above-mentioned blood-pressure value range of every, using the presumed blood-pressure value EBP serially computed in the blood-pressure value presumption means 80 as an actual blood-pressure value. in addition, the above-mentioned highest-blood-pressure value BPSYS replacing with -- lowest-blood-pressure value BPDIA or the case where the coefficient value of the group corresponding to the mean-blood-pressure value BPMEAN is chosen -- the blood-pressure value presumption means 80 -- setting -- presumed lowest-blood-pressure value EBPDIA

Or the presumed mean-blood-pressure value EBPMEAN is computed.
[0031] Drawing 5 is drawing showing an example of two or more sets of coefficient values memorized for two or more blood-pressures value range of every with which it is used in the above-mentioned coefficient decision means 82. In drawing 5 , 1 set of alpha, beta, and gamma are memorized every 40mmHg(s) of an actual blood-pressure value. Usually, if a blood-pressure value increases, since the inverse number (1/DTRP) of time difference will increase and a cardiac cycle RR and the plethysmogram surface ratio VR will tend to decrease, the coefficient alpha memorized in drawing 5 serves as positive, and coefficients beta and gamma serve as a negative value. In addition, two or more sets of coefficient values (alpha, beta, gamma) beforehand memorized for two or more of these blood-pressure value range of every and said constant delta are called for using a multiple regression analysis from the data of the pulse wave propagation time DTRP when the blood-pressure value measured by the cuff etc. and its blood-pressure value are acquired, a cardiac cycle RR, and the a large number people containing the plethysmogram surface ratio VR. That is, in said formula 2, the best unbiased estimate of alpha, beta, gamma, and delta which were called for by the least square method, using it 4 or more sets is memorized for two or more blood-pressure value range of every, using the presumed blood-pressure value EBP as three explanatory variables (independent variable) of DTRP, and RR and VR, and a purpose variable (dependent variable) corresponding to it as 1 set, and it is used.
[0032] The constant decision means 83 in the relation as which the coefficient was determined, using the blood-pressure value measured by the cuff 10 in the coefficient decision means 82 as an actual blood-pressure value The presumed blood-pressure value EBP which assigns the value at the time of the blood pressure measurement using one [at least] of the cuff of the information used for the relation, i.e., said pulse-wave-velocity information, heart rate information, and plethysmogram area information, and is acquired, The constant of the constant term of the relational expression used in the blood-pressure value presumption means 80 is determined so that the blood-pressure value measured using the cuff may be in agreement.
[0033] The autonomic nerve active state analysis means 84 is the pulse wave propagation time DTRP changed in the active state of a living body's autonomic nerve when a living body's blood pressure is changed, and pulse wave velocity VM. And it analyzes based on either [at least] blood-pressure fluctuation information, such as the presumed blood-pressure value EBP, or said heart rate information. That is, the autonomic nerve active state analysis means 84 is equipped with either [at least] a sympathetic nerve active state judging means 86 to judge the active state of a living body's sympathetic nerve based on a low frequency signal component lower enough than a living body's respiratory frequency among the fluctuation frequency components of the living body's blood-pressure fluctuation information, or a parasympathetic nerve active state judging means 88 to judge the active state of a living body's parasympathetic nerve based on the comparatively high RF signal component near a living body's respiratory frequency among the fluctuation frequency components of the living body's heart rate information.
[0034] The coefficient modification means 90 changes into a blood-pressure change amplification side the coefficient of the relation used in the blood-pressure value presumption means 80 based on the active state of the autonomic nerve analyzed in the autonomic nerve active state analysis means 84. Namely, decision whether the active state of the sympathetic nerve in the sympathetic nerve active state judging means 86 exceeded the predetermined range to the large side, And when one decision of the decision whether the active state of the parasympathetic nerve in the parasympathetic nerve active state judging means 88 exceeded the predetermined range to the small side is affirmed, Or it is judged with the active state of the sympathetic nerve having exceeded the predetermined range to the large side in the sympathetic nerve active state judging means 86. and when judged with the active state of the parasympathetic nerve having exceeded the predetermined range to the small side in the parasympathetic nerve active state judging means 88 By changing into the side to which the presumed blood-pressure value EBP becomes large of the coefficients alpha, beta, and gamma of said formula 2 about at least one Decision whether it changed into the side by which change of the presumed blood-pressure value EBP is amplified, and the active state of the parasympathetic nerve in the parasympathetic nerve active state judging means 88 exceeded the predetermined range to the large side, And when one decision of the decision whether the active state of the sympathetic nerve in the sympathetic nerve active state judging means 86 exceeded the predetermined range to the small side is affirmed, Or it is judged with the active state of the parasympathetic nerve having exceeded the predetermined range to the large side in the parasympathetic nerve active state judging means 88. and when judged with the active state of the sympathetic nerve having exceeded the predetermined range to the small side in the sympathetic nerve active state judging means 86 It changes into the side by which change of the presumed blood-pressure value EBP is amplified by changing into the side to which the presumed blood-pressure value EBP becomes small of the coefficients alpha, beta, and gamma of said formula 2 about at least one. That is, a coefficient is changed into the blood-pressure monitor safety side to which blood-pressure change is carried out certainly and promptly about a blood-pressure monitor. Furthermore, the coefficient modification means 90

returns the coefficient of the relation used in the blood-pressure value presumption means 80 changed based on the active state of the sympathetic nerve and the parasympathetic nerve to the value determined in the coefficient decision means 82, when the active state of the sympathetic nerve returns to predetermined within the limits, or when the active state of the parasympathetic nerve returns to predetermined within the limits.

[0035] Here, the reason for changing the coefficient of the relation used in the blood-pressure value presumption means 80 by said coefficient modification means 90 is explained. These cardiac outputs and peripheral vascular resistance are adjusted by sthenia and control of an activity of the sympathetic nerve and the parasympathetic nerve reflecting the cardiac output and peripheral vascular resistance to which heart rate information and plethysmogram area information change blood pressure as mentioned above. Therefore, decision whether the active state of the sympathetic nerve in the sympathetic nerve active state judging means 86 exceeded the predetermined range to the large side, And when one decision of the decision whether the active state of the parasympathetic nerve in the parasympathetic nerve active state judging means 88 exceeded the predetermined range to the small side is affirmed, Or it is judged with the active state of the sympathetic nerve having exceeded the predetermined range to the large side in the sympathetic nerve active state judging means 86. and when judged with the active state of the parasympathetic nerve having exceeded the predetermined range to the small side in the parasympathetic nerve active state judging means 88 Since it is presumed that the blood-pressure value is increasing (it is high), at least one of the coefficients of the relation used in said blood-pressure value presumption means 80 is switched to the side to which the presumed blood-pressure value EBP becomes large. Decision whether the active state of the parasympathetic nerve in the parasympathetic nerve active state judging means 88 exceeded the predetermined range to the large side, And when one decision of the decision whether the active state of the sympathetic nerve in the sympathetic nerve active state judging means 86 exceeded the predetermined range to the small side is affirmed, Or it is judged with the active state of the parasympathetic nerve having exceeded the predetermined range to the large side in the parasympathetic nerve active state judging means 88. and when judged with the active state of the sympathetic nerve having exceeded the predetermined range to the small side in the sympathetic nerve active state judging means 86 Since it is presumed that the blood-pressure value is decreasing (it is low), at least one of the coefficients of the relation used in said blood-pressure value presumption means 80 is switched to the side to which the presumed blood-pressure value EBP becomes small.

[0036] An alarm judging means 92 to function as an alarm judging means Said blood-pressure fluctuation information changed when the blood pressure of the biological information which changes in relation to a living body's blood pressure, i.e., a living body, is changed, It judges whether said plethysmogram area information reflecting the peripheral vascular resistance fluctuated in order to adjust blood pressure to a said heart rate information [relevant to the heart rate fluctuated in order to adjust blood pressure to a heart side], and tip side exceeded the range of alarm (ALL -ALH) set up beforehand. The above-mentioned range of alarm (ALL -ALH) is based on whether it is the area within risk of a living body's blood pressure needing urgent medical aid, is appointed, may be a fixed range and may be made into the predetermined range of the rate of change or change rate to said biological information at the time of the blood pressure measurement by the last cuff 10.

[0037] It judges whether the alert judging means 94 exceeded the watch range (ATL -ATH) where said biological information was beforehand set up in the range narrower than the range of alarm (ALL -ALH) in said range of alarm set up beforehand. Namely, maximum ATH of the above-mentioned watch range (ATL -ATH) (upper limit) And the minimum value ATL (lower limit) Maximum ALH of said range of alarm (ALL -ALH) (upper limit) And the minimum value ALL (lower limit) A living body's condition is set as a safe condition. Maximum ATH of the above-mentioned watch range Maximum ALH of said range of alarm It is set as a predetermined value or a value only with a low predetermined rate, and is the minimum value ATL of the above-mentioned watch range. The minimum value ALL of said range of alarm It is set as the predetermined value or the value only with a high predetermined rate.

[0038] When it is judged that said biological information exceeded the watch range (ATL -ATH) with the alert judging means 94, and when a predetermined blood-pressure-measurement period comes, the blood-pressure-measurement means 96 changes the compression pressure force of a cuff 10, and measures a living body's blood-pressure value automatically based on change of the magnitude of the pulse wave generated in the process of the compression pressure force. The compression pressure force of the cuff 10 wound around a living body's overarm For example, the predetermined target preassure force value PCM [within the **** pressure-lowering period made to carry out **** pressure lowering at the rate of 3 mmHg/sec degree after carrying out a rapid pressure up to (for example, the pressure value of a 180mmHg degree)] pulse wave signal SM 1 by which sequential extraction is carried out the oscillometric method which was easy to be based on change of the amplitude of the pulse wave to express, and was known -- using -- the highest-blood-pressure value BPSYS, the mean-blood-pressure value BPMEAN, and lowest-blood-pressure value BPDIA etc. -- it determines.

[0039] In order to show serial change, watch range (ATL -ATH), and range of alarm (ALL -ALH) of said biological information, the display means 98 While displaying the up Norio object information searched for serially or its rate of change along with a time-axis in a 2-dimensional coordinate with the shaft in which a time-axis, up Norio object information, or its rate of change is shown Alarm Rhine LAL which shows the boundary of watch Rhine Local Area Transport which shows the boundary of the above-mentioned watch range (ATL -ATH), and a range of alarm (ALL -ALH) is displayed in parallel with a time-axis. Moreover, the message which shows that said biological information exceeded said watch Rhine Local Area Transport or alarm Rhine LAL and which was set up beforehand is expressed as an alphabetic character or voice.

[0040] Drawing 6 is a flow chart explaining the important section of the control actuation in the electronic control 28 of the above-mentioned noninvasive continuation blood-pressure presumption equipment 8, and is a flow chart explaining a presumed blood-pressure value EBP formula decision routine. In drawing 6 , initial processing which clears the flag which is not illustrated, a counter, and a register is performed at a step SA 1 (a step is skipped hereafter.).

[0041] In SA2 corresponding to the continuing pulse-wave-velocity information calculation means 70, in a cuff pressure-up period, after the time difference TDRP from the R wave of an electrocardio induction wave to the standup point of a photoelectrical pulse wave is computed, SA3 thru/or SA4 corresponding to the circulation information calculation means 72 is performed. That is, at SA3 corresponding to the heart rate information calculation means 74, a cardiac cycle RR (sec) is computed from the time interval of the R wave of an electrocardio induction wave, and the plethysmogram surface ratio VR (= VP/RR) is computed by breaking the area VP for one pulse wave of a photoelectrical pulse wave by the cardiac cycle RR computed by SA3 by SA4 corresponding to the plethysmogram area information calculation means 76.

[0042] Subsequently, SA5 thru/or SA7 corresponding to the blood-pressure-measurement means 96 is performed. First, when a diverter valve 16 is switched to a pressure supply condition and an air pump 18 drives in SA5, at SA6 which the rapid pressure up of a cuff 10 is started for blood pressure measurement, and continues, it is cuff pressure PC. It is judged whether it became more than the aim compression pressure PCM beforehand set as the 180mmHg degree. It is cuff pressure PC by carrying out repeat activation of two or less above SA, when decision of this SA6 is denied. A rise is continued.

[0043] However, cuff pressure PC If decision of the above SA 6 is affirmed by rise, a blood-pressure-measurement algorithm will be performed in SA7. Namely, by making it descend at speed with loose 3 mmHg/sec degree which was made to suspend an air pump 18, and switched the change-over valve 16 to the **** exhaust-gas-pressure condition, and was able to define the pressure in a cuff 10 beforehand Pulse wave signal SM 1 serially acquired in this **** pressure-lowering process It is based on change of the amplitude of the pulse wave to express. The blood-pressure value decision algorithm of an oscillograph metric method known well is followed, and they are the highest-blood-pressure value BPSYS, the mean-blood-pressure value BPMEAN, and the lowest-blood-pressure value BPDIA. While being measured, a pulse rate etc. is determined based on a pulse wave gap. And while the blood-pressure value, pulse rate, etc. which were measured are displayed on a drop 32, a change-over valve 16 is switched to a rapid exhaust-gas-pressure condition, and exhaust gas pressure of the inside of a cuff 10 is carried out quickly.

[0044] Highest-blood-pressure value BPSYS measured in SA7 from two or more sets of coefficient values (alpha, beta, gamma) beforehand memorized in SA8 corresponding to the continuing coefficient decision means 82 for every blood-pressure value range as shown in drawing 5 By choosing 1 set of corresponding coefficient values, the coefficient of the formula 2 used in order to compute the presumed blood-pressure value EBP is determined.

[0045] Highest-blood-pressure value BPSYS by which the value computed when the time difference DTRP, the cardiac cycle RR, and the plethysmogram surface ratio VR which were computed by the right-hand side of a formula 2 by SA2 thru/or SA4 are substituted for SA9 corresponding to the continuing constant decision means 83 was measured in SA7 A constant delta is determined will be in agreement. For example, if the time difference DTRP computed in SA2 thru/or SA4, a cardiac cycle RR, and plethysmogram surface ratio VR are set to DTRP0, RR0, and VR0, the formula shown in a formula 3 will be obtained. That is, a constant delta is determined by the formula 4 which transformed the formula 3.

[0046]

[Equation 3] BPSYS =alpha(1-/DTRP0)+betaRR0+gammaVR0+delta[0047]

[Equation 4] Delta=BPSYS -{alpha(1-/DTRP0)+betaRR0+gammaVR0}

[0048] Drawing 7 is a flow chart explaining the important section of the control actuation in the electronic control 28 of said noninvasive continuation blood-pressure presumption equipment 8, and is a flow chart explaining the blood-pressure executive routine performed following the presumed blood-pressure value EBP formula decision routine shown in drawing 6 .

[0049] By SB1, it is judged first whether a part for a thread wave of the R wave of an electrocardio wave and a

photoelectrical pulse wave was inputted. Although repeat activation of SB1 is carried out when decision of this SB1 is denied In SB2 corresponding to the pulse-wave-velocity information calculation means 70 which continues when affirmed, SB3 corresponding to the heart rate information calculation means 74, and SB4 corresponding to the plethysmogram area information calculation means 76 Time difference TDRP, a cardiac cycle RR, and the plethysmogram surface ratio VR are computed by carrying out the same processing as SA2 of drawing 6 thru/or SA4.

[0050] The formula 2 as which the coefficient and the constant were determined in SA8 thru/or SA9 of drawing 6 using the time difference DTRP computed in SB2 thru/or SB4, a cardiac cycle RR, and the pulse wave surface ratio VR in SB5 corresponding to the continuing blood-pressure value presumption means 80 to presumed blood-pressure value EBPSYS It is computed.

[0051] The time-axis and the presumed highest-blood-pressure value EBPSYS which are displayed on the predetermined location of a drop 32 in SB6 corresponding to the continuing display means 98 as shown in drawing 8 In a 2-dimensional coordinate with a shaft Presumed blood-pressure value EBPSYS computed in SB5 While a trend display is carried out along with a time-axis The minimum value ALL of a range of alarm Shown bottom alarm Rhine LALL and maximum ALH of a range of alarm Shown top alarm Rhine LATH It is displayed in parallel with a time-axis. Furthermore, the bottom alarm Rhine LALL It is the minimum value ATL of a watch range to the bottom. Shown bottom watch Rhine LATL It is displayed in parallel with a time-axis. Top alarm Rhine LATH It is the maximum ATH of a watch range to the bottom. Shown bottom watch Rhine LATH It is displayed in parallel with a time-axis.

[0052] SB7 corresponding to the continuing coefficient decision means 82 is the presumed blood-pressure value EBPSYS computed by said SB5. A coefficient value to two or more sets of the presumed blood-pressure values EBPSYS which used as an actual blood-pressure value and were beforehand memorized for said two or more blood-pressure value range of every The coefficient value of a corresponding group is chosen. Thus, presumed blood-pressure value EBPSYS computed serially Blood-pressure presumption precision improves by determining the coefficient of said formula 2 serially using a value.

[0053] In continuing SB8, the coefficient modification judging routine which judges whether the coefficient value determined by the time difference DTRP computed by SB2 thru/or SB3 and the cardiac cycle RR by SB7 is changed is performed. This coefficient modification judging routine is explained to drawing 9 in detail.

[0054] In drawing 9 , SC1 thru/or SC4 corresponding to the autonomic nerve active state analysis means 84 is performed first. That is, SC1 corresponding to the sympathetic nerve active state judging means 86 thru/or SC2 and SC3 corresponding to the parasympathetic nerve active state judging means 88 thru/or SC4 are performed.

[0055] In SC1, frequency analysis of the fluctuation of the time difference DTRP currently serially computed in SB2 is carried out. There is fluctuation in time difference DTRP as shown in drawing 10 as fluctuation of the inverse number (1/DTRP) of time difference DTRP. If frequency analysis (analysis of a spectrum) of the above-mentioned fluctuation is carried out by the fast-Fourier-transform method **** autoregression method, the spectrum shown in drawing 11 with a dashed line will be obtained. 1/3 of the comparatively high RF signal component HFDT near living body's respiratory frequency and a living body's respiratory frequency thru/or the low frequency signal component LFDT of about 1/4 frequency exist in this spectrum.

[0056] In continuing SC2, the ratio (LFDT/HFDT) of the amplitude reinforcement of the low frequency signal component LFDT of the frequency analysis spectrum of the inverse number (1-/DTRP) of the time difference acquired by SC1 and the amplitude reinforcement of the RF signal component HFDT is computed as an index showing the active state of the sympathetic nerve. Since the amplitude reinforcement of the above-mentioned low frequency signal component LFDT is known as a thing used as the quantitive index of a sympathetic nerve activity and the amplitude reinforcement of the RF signal component HFDT is not influenced of an autonomic nerve activity on the other hand, the above-mentioned ratio (LFDT/HFDT) serves as an index of the sympathetic nerve activity except the effect of individual difference.

[0057] In continuing SC3, frequency analysis of the fluctuation of the cardiac cycle RR currently serially computed in SB3 is carried out. There is fluctuation also in a cardiac cycle RR as shown in drawing 10 . If frequency analysis (analysis of a spectrum) of the above-mentioned fluctuation is carried out by the fast-Fourier-transform method **** autoregression method, the spectrum shown in drawing 11 as a continuous line will be obtained. 1/3 of the comparatively high RF signal component HFRR near living body's respiratory frequency and a living body's respiratory frequency thru/or about 1/4 low frequency signal component LFRR exists in this spectrum like the frequency analysis spectrum of the inverse number (1-/DTRP) of time difference.

[0058] In continuing SC4, the ratio (HFRR/LFRR) of the amplitude reinforcement of the RF signal component HFRR of the frequency analysis spectrum of the cardiac cycle RR obtained by SC3 and the amplitude reinforcement of the low frequency signal component LFRR is computed as an index showing the active state of the parasympathetic nerve.

Since the amplitude reinforcement of the above-mentioned RF signal component HFRR is known as a thing used as the quantitive index of a parasympathetic nerve activity and the amplitude reinforcement of the low frequency signal component LFRR is not influenced of an autonomic nerve activity on the other hand, the above-mentioned ratio (HFRR/LFRR) serves as an index of the parasympathetic nerve activity except the effect of individual difference.

[0059] Next, SC5 thru/or SC10 corresponding to the coefficient modification means 90 is performed. By SC5, it is judged first whether the sympathetic nerve activity index (LFDT/HFDT) called for by SC2 and the parasympathetic nerve activity indexes (HFRR/LFRR) called for by SC4 are both predetermined within the limits. The above-mentioned predetermined range is beforehand set up, in order to judge sthenia and control of a sympathetic nerve activity and a parasympathetic nerve activity, may be a fixed range and may be made into the predetermined range of the rate of change or change rate to the sympathetic nerve activity index (LFDT/HFDT) at the time of the blood pressure measurement by the last cuff 10, and a parasympathetic nerve activity index (HFRR/LFRR).

[0060] Since the active state of an autonomic nerve is comparatively stable when decision of the above SC 5 is affirmed, in continuing SC6, the coefficient value determined by SB7 is determined as a coefficient value used for a formula 2, and this routine is terminated. That is, when the coefficient value of a formula 2 is a value determined in SB7, the coefficient value is already maintained, and when the coefficient value used for said formula 2 in SC8 or SC10 mentioned later is made to change, it is returned to the coefficient value determined in SB7.

[0061] However, when decision of the above SC 5 is denied, in continuing SC7, it is judged whether the predetermined range where the sympathetic nerve activity index (LFDT/HFDT) called for by SC2 exceeded the predetermined range set up beforehand to the large side, and the parasympathetic nerve activity index (HFRR/LFRR) was set up beforehand was exceeded to the small side. Although SC9 is directly performed when decision of the above SC 7 is denied Since it is presumed that a cardiac output and peripheral vascular resistance are changing with sthenia of an activity of the sympathetic nerve and control of an activity of the parasympathetic nerve to the side which raises blood pressure a lot when affirmed In order to carry out a blood-pressure monitor to safety more, change of the presumed blood-pressure value EBP computed by said formula 2 is made to amplify in continuing SC8. That is, the value of the coefficients beta and gamma of the cardiac cycle RR which is the term which reflects the cardiac output and peripheral vascular resistance in said formula 2, and the plethysmogram surface ratio VR is increased so that the presumed blood-pressure value EBP computed when the inverse number (1-/DTRP) of the same time difference as a formula 2, a cardiac cycle RR, and the plethysmogram surface ratio VR are substituted may become large. For example, when the coefficient before being changed is set to beta 0 and gamma 0 (value negative in beta 0 and gamma 0), it is 0.5beta0 and 0.5gamma0. It is changed.

[0062] In continuing SC9, it is judged whether the predetermined range where the sympathetic nerve activity index (LFDT/HFDT) called for by SC2 exceeded the predetermined range set up beforehand to the small side, and the parasympathetic nerve activity index (HFRR/LFRR) was set up beforehand was exceeded to the large side. In order to carry out a blood-pressure monitor to safety more, change of the presumed blood-pressure value EBP computed by said formula 2 is made to amplify in continuing SC10, since this routine is terminated when decision of the above SC 9 is denied, but it is presumed that a cardiac output and peripheral vascular resistance are changing with control of an activity of the sympathetic nerve and sthenia of an activity of the parasympathetic nerve to the side to which blood pressure is reduced a lot when affirmed. That is, the value of the cardiac cycle RR of said formula 2 and the coefficients beta and gamma of the plethysmogram surface ratio VR is decreased so that the presumed blood-pressure value EBP computed when the inverse number (1-/DTRP) of the same time difference as a formula 2, a cardiac cycle RR, and the plethysmogram surface ratio VR are substituted may become small. For example, when the coefficient before being changed is set to beta 0 and gamma 0 (value negative in beta 0 and gamma 0), it is 2beta0 and 2gamma0. It is changed.

[0063] In SB9 corresponding to the alarm judging means 92 which returns and follows drawing 7 The range of alarm where the presumed blood-pressure value EBP computed by SB5 was defined beforehand (ALL -ALH), For example, it is based on the presumed blood-pressure value EBP first computed in SB5 after [which is depended on a cuff 10 in SA7 of drawing 6] blood pressure measurement is carried out. The minimum value ALL of the range of alarm set up as a value which changed from the presumed blood-pressure value EBP to the bottom 30% Maximum ALH of the range of alarm set up as a value which changed from whether it exceeded and or not its presumed blood-pressure value EBP to the bottom 30% It is judged whether it exceeded or not.

[0064] Although decision of SB11 is directly performed when decision of the above SB 9 is denied, when it is affirmed, the alarm tone or the message which shows that the presumed blood-pressure value EBP exceeded the range of alarm from the loudspeaker which the alphabetic character or the mark which shows that the presumed blood-pressure value EBP exceeded the range of alarm is displayed on a drop 32, and is not illustrated in SB10 corresponding to the continuing display means 98 is outputted.

[0065] The presumed blood-pressure value EBP computed by SB5 in SB11 corresponding to the continuing alert judging means 94 is the maximum ATH of a watch range. Or the minimum value ATL of a watch range It is judged whether it exceeded or not. Maximum ATH of the above-mentioned watch range For example, maximum ALH of said range of alarm It is decided beforehand 15 mmHgs that it will be a low value, and it is the minimum value ATL of the above-mentioned watch range. For example, the minimum value ALL of said range of alarm It is decided beforehand 15 mmHgs that it will be a high value.

[0066] In SB13 corresponding to the display means 98 which continues when decision of the above SB 11 is affirmed The alphabetic character or mark which shows that the presumed blood-pressure value EBP exceeded the watch range is displayed on a drop 32. and after the watch sound or message which shows that the presumed blood-pressure value EBP exceeded the watch range from the loudspeaker which is not a drawing example is outputted, blood pressure measurement by the cuff 10 is performed by performing the presumed blood-pressure value EBP formula decision routine of drawing 6 . For example, it sets to drawing 8 and is time amount tATH. Blood pressure measurement by the cuff 10 is performed at the time. therefore, when judged with blood-pressure executive routine of drawing 7 having been performed again, and the presumed blood-pressure value EBP having exceeded the range of alarm (ALL -ALH) in SB9 The time tALH of being judged with the presumed blood-pressure value EBP having exceeded the range of alarm, since the blood pressure measurement by the cuff 10 is already started, for example, time amount of drawing 8 , Rather than the case where the blood pressure measurement by the cuff 10 is started at the time, the blood-pressure-measurement value by the cuff 10 is acquired at an early stage.

[0067] However, blood-pressure-measurement period TB beforehand set up in continuing SB12 from the last blood pressure measurement measured using the cuff in the presumed blood-pressure value EBP formula decision routine of drawing 6 when decision of the above SB 11 was denied It is judged whether it passed or not. This blood-pressure-measurement period TB For example, it is comparatively set as long duration like about ten minutes thru/or dozens of minutes. When decision of this SB12 is denied, repeat activation of said SB1 or subsequent ones is carried out, since it is the blood-pressure-measurement stage to come periodically when affirmed, in the presumed blood-pressure value EBP formula decision routine of drawing 6 , blood pressure measurement is performed by the oscillometric method using a cuff 10, and the coefficient (alpha, beta, gamma) and constant delta of a formula 2 are re-determined.

[0068] According to this example, it is based on actual time difference DTRP and an actual cardiac cycle RR, and the plethysmogram surface ratio VR with the blood-pressure value presumption means 80 (SB5) as mentioned above from the relation (formula 2) between the presumed blood-pressure value EBP, the pulse wave propagation time DTRP, a cardiac cycle RR, and the plethysmogram surface ratio VR memorized beforehand, and is the presumed blood-pressure value EBPSYS. Presumed blood-pressure value EBPSYS since it is computed It receives and a high presumed precision is acquired. Namely, when a living body's blood-pressure value is presumed based on time difference DTRP, it compares. Since the plethysmogram surface ratio VR which is a parameter by the side of the tip which changes in relation to the cardiac cycle RR which is a parameter by the side of the heart which changes in relation to a living body's blood-pressure value, and a living body's blood-pressure value is used further Presumed blood-pressure value EBPSYS It receives, and presumed precision does not need to be raised further and proofreading with the blood-pressure value BP measured using the cuff 10 does not need to be performed frequently. moreover, with the coefficient decision means 82 (SA8, SB7) from two or more sets of coefficient values beforehand memorized for two or more blood-pressure value range of every The highest-blood-pressure value BPSYS measured using the cuff 10, or presumed highest-blood-pressure value EBPSYS computed serially From the coefficient of the formula 2 used in the blood-pressure value presumption means 80 (SB5) by choosing the coefficient value of a corresponding group being determined As compared with the case where the coefficient of a formula 2 is the constant value defined beforehand, the precision of a formula 2 is raised and it is the presumed highest-blood-pressure value EBPSYS. There is an advantage acquired correctly.

[0069] Moreover, since the coefficients alpha, beta, and gamma and constant delta which are used in said formula 2 are called for using a multiple regression analysis from the data of the pulse wave propagation time DTRP when the blood-pressure value measured by the cuff 10 grade and its blood-pressure value are acquired, a cardiac cycle RR, and the a large number people containing the plethysmogram surface ratio VR according to this example, there is an advantage from which the relation in which the general purpose for acquiring the presumed blood-pressure value EBP is possible is obtained.

[0070] According to this example, moreover, the coefficient decision means 82 (SB7) Presumed highest-blood-pressure value EBPSYS presumed by the blood-pressure value presumption means 80 (SB5) as said living body's actual blood-pressure value It uses. A coefficient value to two or more sets of presumed highest-blood-pressure values EBPSYS beforehand memorized for said two or more blood-pressure value range of every The coefficient of the formula 2 used

in the blood-pressure value presumption means 80 (SB5) is determined by choosing the coefficient value of a corresponding group. Therefore, presumed highest-blood-pressure value EBPSYS presumed serially There is an advantage for which the coefficient value of the optimal corresponding group is used promptly.

[0071] Moreover, pulse wave signal SM 1 generated in the process in which the compression pressure of the cuff 10 wound around some living bodies is changed according to this example A blood-pressure-measurement means 96 (SA [5] thru/or SA7) to determine a living body's blood-pressure value BP based on change of the amplitude of the pulse wave to express is included. The coefficient decision means 82 (SA8) Highest-blood-pressure value BPSYS measured in the blood-pressure-measurement means 96 (SA [5] thru/or SA7) as said living body's actual blood-pressure value It uses. A living body's highest-blood-pressure value BPSYS measured using the cuff 10 from two or more sets of coefficient values beforehand memorized for said two or more blood-pressure value range of every The coefficient of the formula 2 used in the blood-pressure value presumption means 80 (SB5) is determined by choosing the coefficient value of a corresponding group. Therefore, a living body's more reliable highest-blood-pressure value BPSYS measured using the cuff 10 There is an advantage for which the coefficient value (alpha, beta, gamma) of the optimal corresponding group is used promptly.

[0072] Moreover, the noninvasive continuation blood-pressure presumption equipment 8 of this example Highest-blood-pressure value BPSYS measured using the cuff 10 in the coefficient decision means 82 (SA8) To the formula 2 as which the coefficient value of a corresponding group was chosen presumed blood-pressure value EBPSYS which assigns the value at the time of the blood pressure measurement using the cuff 10 of time difference DTRP, a cardiac cycle RR, and the plethysmogram surface ratio VR, and is acquired Highest-blood-pressure value BPSYS measured using the cuff 10 Since a constant decision means 83 (SA9) to determine the constant delta of a formula 2 is included so that it may be in agreement Presumed blood-pressure value EBPSYS presumed in the blood-pressure value presumption means 80 (SB5) There is an advantage to which reliability becomes still higher.

[0073] As mentioned above, although one example of this invention was explained to details based on the drawing, this invention is applied also in other modes.

[0074] For example, in the blood-pressure value presumption means 80 (SB5) of the above-mentioned example, although the both sides of the plethysmogram surface ratio VR which is the cardiac cycle RR and plethysmogram area information which are heart rate information were used, even if the formula 2 which computes the presumed blood-pressure value EBP is only either, presumed precision is raised as compared with conventional blood-pressure supervisory equipment.

[0075] Moreover, in the above-mentioned example, in the formula 2 which computes the presumed blood-pressure value EBP, although time difference DTRP, a cardiac cycle RR, and the plethysmogram surface ratio VR were primary types, respectively, they may be the 2nd more than order and may contain a trigonometric function and a logarithmic function. For example, you may be a formula as shown in a formula 5 and a formula 6.

[0076]

[Equation 5] EBP=alpha (1-/DTRP) +gammaVR2+delta (alpha and gamma are a coefficient and delta is a constant)

[0077]

[Equation 6] EBP=alpha (1-/DTRP) +betalog(RR)+gamma VR+delta (alpha, beta, and gamma are a coefficient, and delta is a constant)

[0078] Moreover, in the above-mentioned example, although the formula which computes the presumed blood-pressure value EBP was only a formula 2, the presumed blood-pressure value EBP may be computed by a formula which is different for every blood-pressure value range defined beforehand like the coefficient used in the formula 2 being used.

[0079] Moreover, in the above-mentioned example, in SA8 and SB7 corresponding to the coefficient decision means 82, although the value of three coefficients of coefficients alpha, beta, and gamma was determined based on the actual blood-pressure value, only the value of the coefficient from which the effect on the presumed blood-pressure value EBP differs may be determined by the range of blood pressure based on an actual blood-pressure value, and other coefficients may be made constant value.

[0080] Moreover, the blood-pressure-measurement means 96 of the above-mentioned example was constituted so that blood pressure might be measured by the so-called oscillograph metric method, but even if it carries out blood pressure measurement with the so-called K sound method which determines the cuff pressure at the time of generating of Korotkoff sounds, and disappearance as a highest-blood-pressure value and a lowest-blood-pressure value, it does not interfere.

[0081] Moreover, in the above-mentioned example, although time difference DTRP was computed based on the time difference from an R wave to the standup point of a photoelectrical pulse wave, other calculation methods, such as using the time difference from the Q wave of an electrocardio wave to the standup point of a photoelectrical pulse wave, are

used.

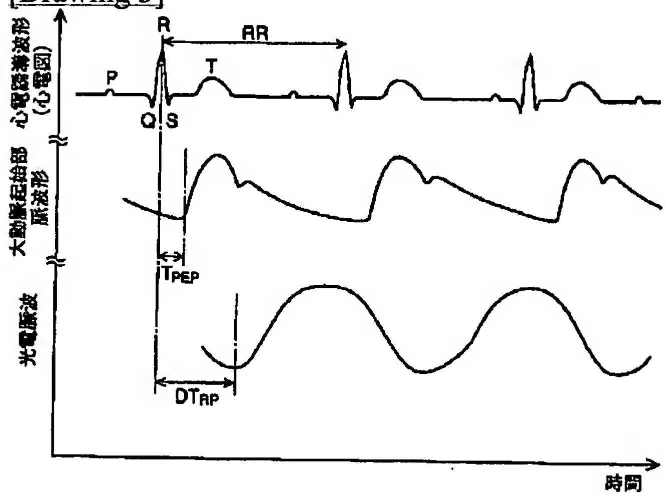
[0082] Moreover, in the above-mentioned example, although the presumed blood-pressure value EBP was computed for every beat of an R wave or a photoelectrical pulse wave, the presumed blood-pressure value EBP may be computed for every two or more numbers of beats.

[0083] In addition, in addition to this in the range in which this invention does not deviate from the main point, various modification may be added.

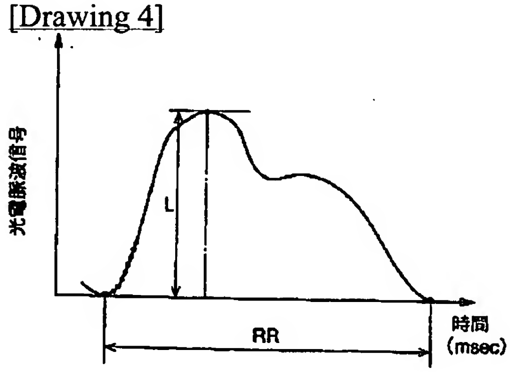
[Translation done.]

DRAWINGS

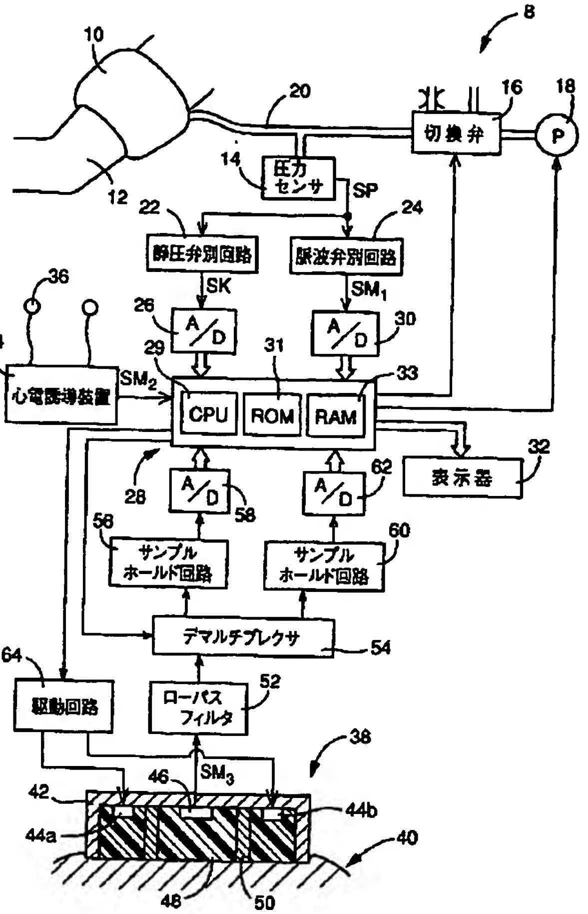
[Drawing 3]



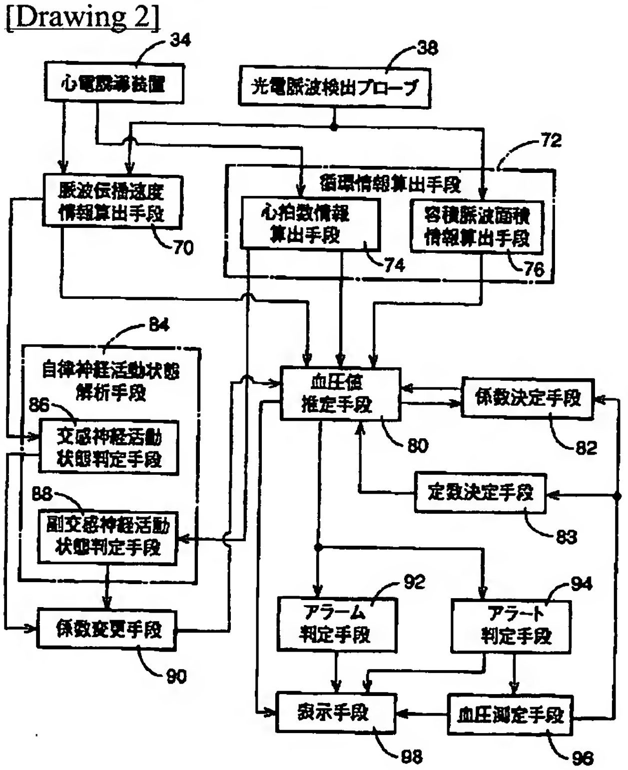
[Drawing 4]



[Drawing 1]



[Drawing 2]

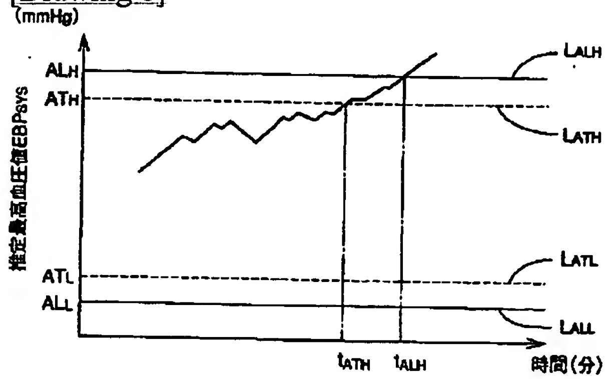


[Drawing 5]

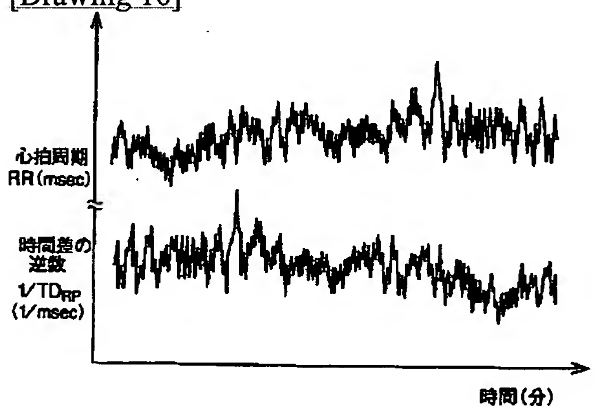
実際の血圧値 (mmHg) / 係数	~40	~80	~120	~160	~200	200~
α	α1	α2	α3	α4	α5	α6
β	β1	β2	β3	β4	β5	β6
γ	γ1	γ2	γ3	γ4	γ5	γ6

（αは正の係数、βおよびγは負の係数）

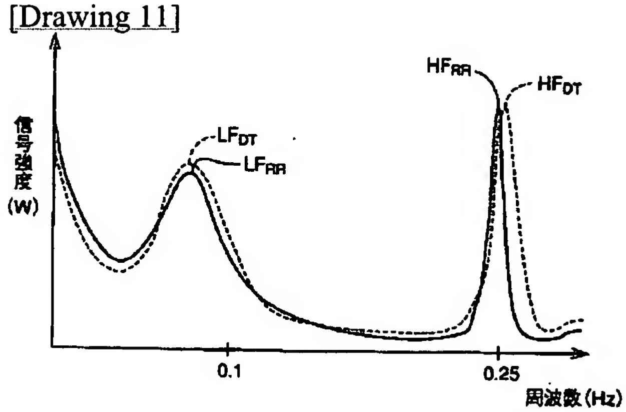
[Drawing 8]



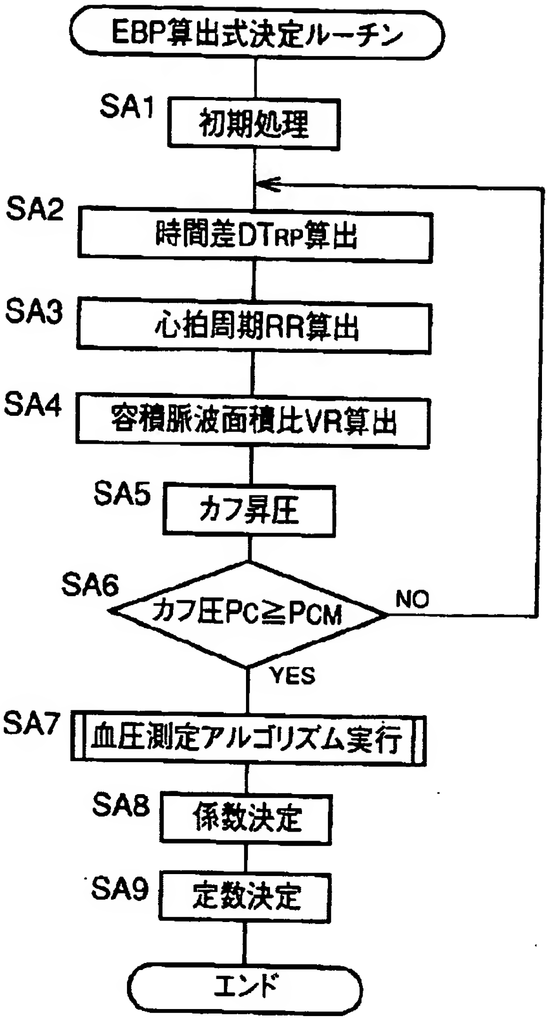
[Drawing 10]



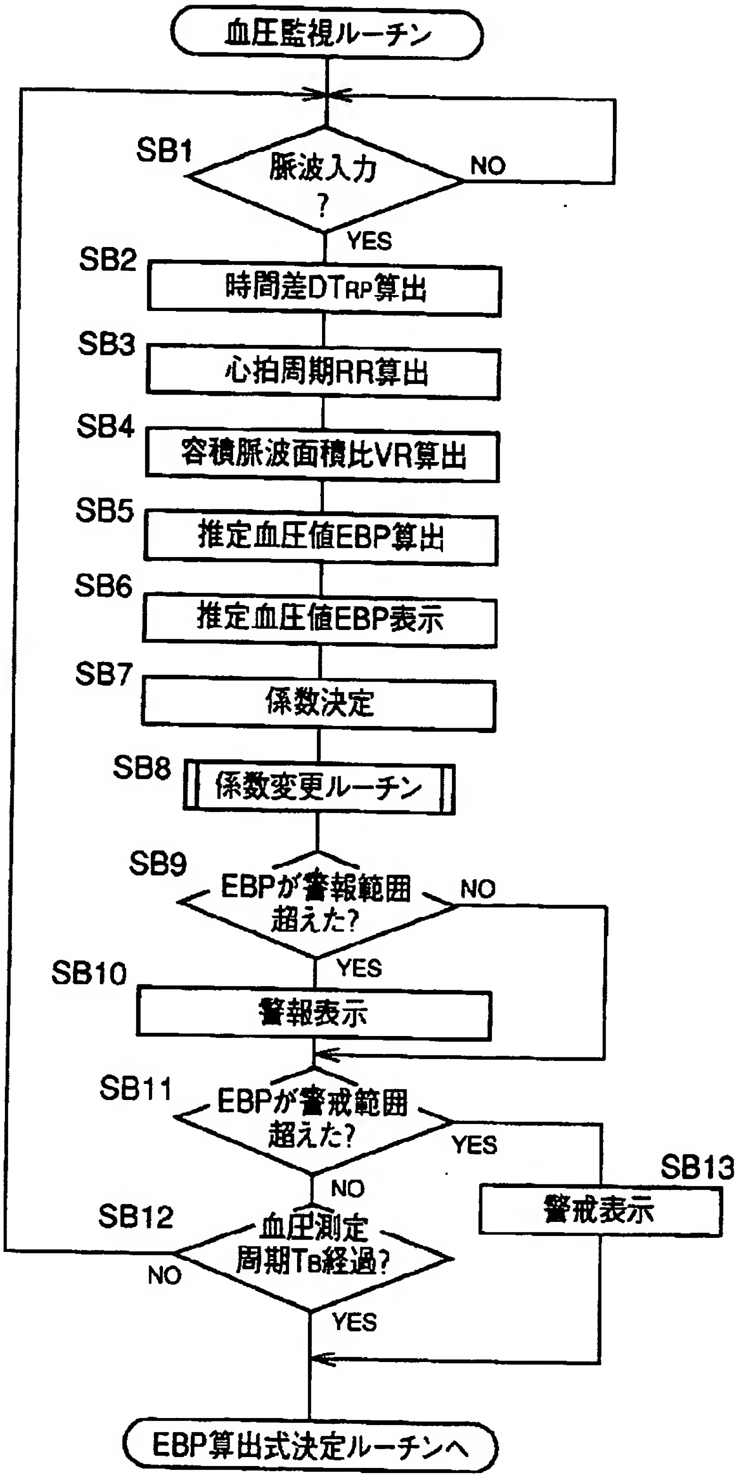
[Drawing 11]



[Drawing 6]

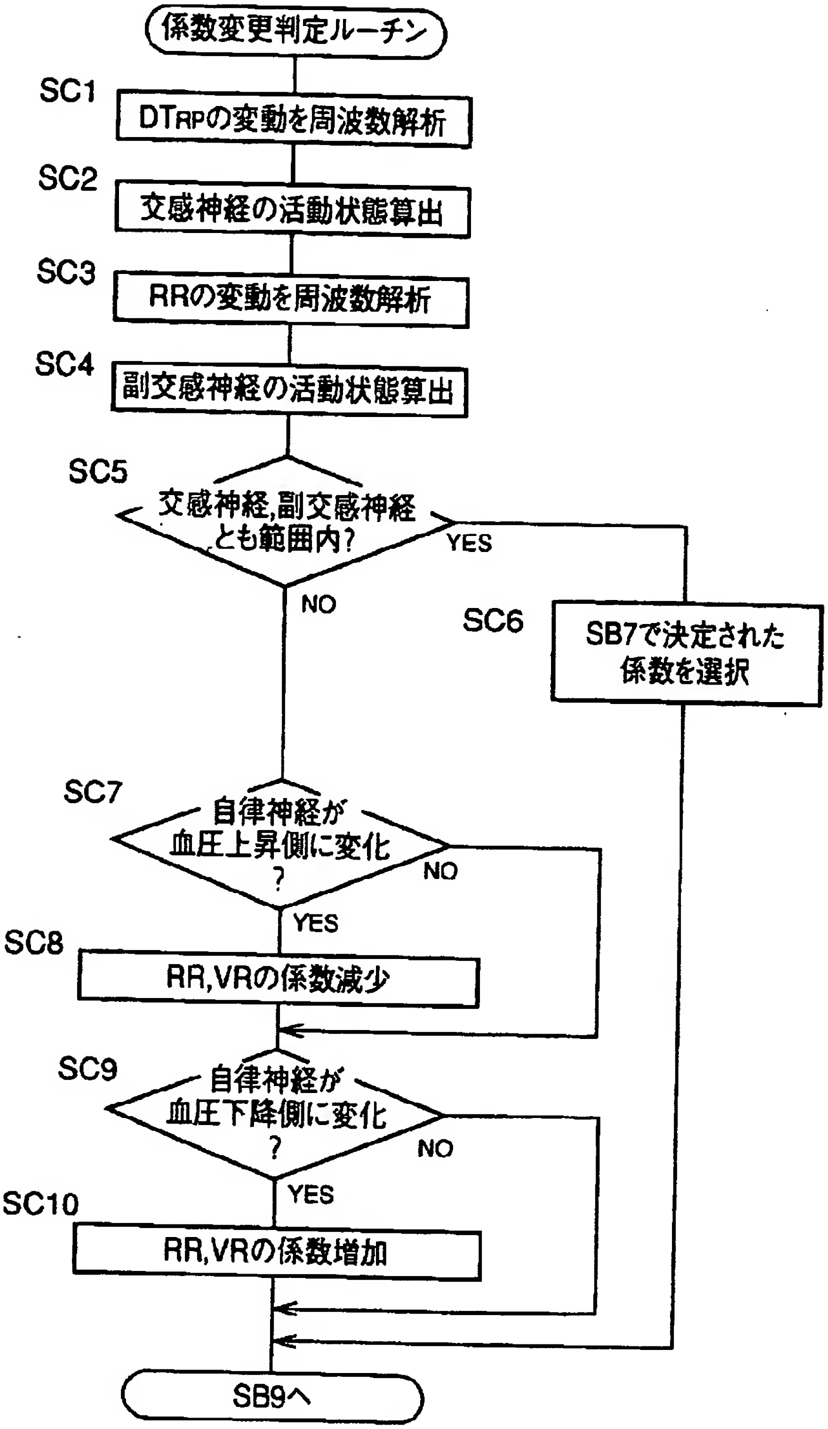

EBP算出式決定ルーチン
SA1
初期処理
SA2
時間差DTRP算出
SA3
心拍周期RR算出
SA4
容積脈波面積比VR算出
SA5
カフ昇圧
SA6
カフ圧PC≧PCM
NO
YES
SA7
血圧測定アルゴリズム実行
SA8
係数決定
SA9
定数決定
エンド

[Drawing 7]



血圧監視ルーチン
SB1
脈波入力?
NO
YES
SB2
時間差DTRP算出
SB3
心拍周期RR算出
SB4
容積脈波面積比VR算出
SB5
推定血圧値EBP算出
SB6
推定血圧値EBP表示
SB7
係数決定
SB8
係数変更ルーチン
SB9
EBPが警報範囲超えた?
NO
YES
SB10
警報表示
SB11
EBPが警戒範囲超えた?
YES
NO
SB13
警戒表示
SB12
血圧測定周期TB経過?
NO
YES
EBP算出式決定ルーチンへ

[Drawing 9]



[Translation done.]